INDIANA STATE POLICE LABORATORY DIVISION

PHYSICAL EVIDENCE BULLETIN

FOOTWEAR & TIRE IMPRESSIONS

Patterns of footwear and tires may be found at crime scenes, usually in the form of 3-dimensional impressions in soil, mud, and snow, or as 2-dimensional prints on floors, glass, doors, etc. By examining characteristics specific to a given shoe or tire, it is possible to identify or exclude them as having made the impression in question.

A. Photography of Footwear/Tire Impression Evidence

1. **Recommended Equipment to Photograph Footwear/Tire Impression Evidence**

    a. Camera with macro lens

    b. Electronic flash with extension cord (3-6 foot)

    c. Tripod

    d. Level

    e. Scale (L-scale preferably)

    f. Measuring tape (An L-scale should be used in addition to the measuring tape. The measuring tape is beneficial in piecing together longer impressions, such as tire impressions.)

    g. Numbered markers/labels

    h. Black cloth, screen, or cardboard to block sunlight

    i. Golf ball markers (to indicate direction of flash)

2. The evidence should be photographed with and without scales and photo evidence markers.

3. All impressions should be sketched and photographed prior to any attempt to lift or cast them.

4. Take overall photographs with photo evidence markers showing the impressions in relation to the scene. Overall photographs can be taken in JPEG (jpg) format.

5. Take close-up comparison quality photographs.

    a. A scale should **ALWAYS** be included in comparison quality photographs and should be in the same plane as the impression. It might be necessary to dig a trench next to the impression to be able to place the scale in the same plane as the impression.

    b. Comparison quality photographs should be taken from directly overhead using a tripod so that the back of the camera is parallel to the impression. This allows the photograph to be sized accurately to 1:1.

    c. If possible, the camera should be set to **Aperture Priority (A)** to control the depth of field when taking comparison quality photographs. An F-stop of F/11 or F/16 is recommended. A tripod should be used. If a tripod cannot be used, then the shutter speed should be set at 1/60 of a second to prevent blurriness from movement.

    d. For multiple impressions, every photograph should have the impression labeled with a unique identifier (number or letter) to differentiate the impressions from one another.

    e. Images should be captured, stored, and transmitted without compression or with lossless compression.

        1) Examples of common file formats that meet this requirement are TIF, RAW, and BMP. TIF is the preferred file format for submission of latent print digital images to the laboratory for examination.
        2) When an image is captured in a RAW format (such as NEF), it may be necessary to convert the file to TIF or BMP format prior to submission to the laboratory. The laboratory may not have the capability to view that particular RAW format.
        3) JPG (jpeg) is a lossy compression file format that can result in pixels being altered in the image. Therefore, it should **NOT** be used to capture an image that is to be used for comparison.

    f. Images should be captured at the highest resolution setting available on the camera. The impression should be photographed so that it fills the frame of the view finder. It may be necessary to take multiple photographs of the impression to achieve high resolution images.

1) When an entire footwear impression is present, photograph the full footwear impression. Then photograph sections of the impression, toe area and heel area, to achieve maximum resolution.

2) For long continuous tire impressions, place a steel tape measure along the length of the impression.

(a) Take overlapping photographs along the impression for at least eight feet (approximately the full circumference of most tires). Overlap the photographs by approximately 2 inches.

(b) Move a small scale and tape measure along the length of the impression while photographing to ensure accuracy in sizing. The small scale should be on the same plane as the impression.

g. For three-dimensional impressions, use a detachable flash held at a 45° angle approximately three feet away from the impression. Take at least three photographs of the impression repositioning the flash around the sides of the impression.

1) For deeper three-dimensional impressions, take three additional photographs with the detachable flash at approximately a 65º angle in three positions around the sides of the impression.

2) For shallow three dimensional impressions, take three additional photographs with the detachable flash at approximately a 25º angle in three positions around the sides of the impression.

h. All comparison quality digital photographs should be burned to a CD and submitted to the laboratory as an item of evidence.

i. Agencies may have to prove that the digital images have not been altered prior to submission to the laboratory. Agencies **MUST** have adequate policies and documentation procedures in place to meet this requirement..

B. Casting Footwear/Tire Impressions

1. Recommended Materials for Dental Stone Casting

a. Dental Stone (DO NOT use Plaster of Paris)

b. Water – one gallon plastic jug

c. Kitchen strainer or flour sifter, one to four cup capacity (optional)

d. Bowls or large plastic bags for mixing Dental Stone solution

e. Large spoon (optional)

f. Casing frame (e.g. aluminum foil, collapsible frame, twigs, cardboard, etc.)

g. Snow Print Wax

h. Aerosol can of lacquer, shellac, or hairspray

2. **Casting Soil Impressions**

a. Photograph using procedures described in Section A, pages 1-3 before casting.

b. Inspect the impression for debris. Sticks, stones, and leaves which have been pressed into the impression as it was made **should not** be removed prior to casting. Debris which has fallen **loosely** into the impression **after** it was made can be carefully picked out.

c. If on a sloped surface, set up a small dam or frame around the impression and force it into the soil at least one inch from the edges of the impression. This frame may be made of aluminum foil, collapsible frame, twigs, cardboard, etc..

d. Prepare the Dental Stone following the mixing instructions provided by the manufacturer. (NOTE: the general guideline is to mix 2 pounds of dental stone with 12 ounces of water to cover one entire footwear impression.)

1) A plastic bag may be used for mixing the dental stone and water.

2) Knead the mixture to prevent trapping air bubbles and to make sure there are no lumps.

3) More Dental Stone or water can be slowly added until the mixture has the consistency of pancake batter.

e. Pour the Dental Stone mixture into the impression **slowly**, so it flows evenly and smoothly over the impression.

1) The stream of liquid can be deflected by using a spoon or flat stick.

2) Once you begin pouring, you should not pour directly onto the impression; instead you should pour onto the previously poured casting material so as not to disturb the impression.

3) The Dental Stone should be poured to a thickness of about 1 inch and allowed to harden. It is not necessary to add reinforcement to the Dental Stone, as it was with Plaster of Paris.

4) If the poured Dental Stone mixture is too thin, sprinkle dry Dental Stone powder on top of the cast to absorb the excess water.

5) If the poured Dental Stone mixture is too thick and will not cover the entire impression, try spreading the top layer of the casting material with a stick into the remaining impression. If the Dental Stone starts to disturb the impression, mix a new batch of Dental Stone and pour on top of the already poured cast.

f. Mark the Dental Stone as it sets and takes on a wet luster having the consistency of modeling clay.

1) Label the cast with the agency case number, date, location, and initials of the person making the cast by inscribing carefully into the cast, or

2) Wait until the cast is dry and label the cast with the above listed information using a permanent marker.

g. Lift the cast when the Dental Stone has set, meaning it is firm to the touch (20-30 minutes).

1) **DO NOT** remove any soil which may be adhering to the cast itself. This process should be left to the laboratory analyst.

2) Casts must be thoroughly dried before packaging. **DO NOT** package in a plastic bag. Casts should be packaged and secured within a cardboard box with something to protect them from breaking, such as butcher paper.

h. If the cast was broken during the lifting process, this should be noted on the Request for Laboratory Examination form.

3. **Casting Sandy Soil Impressions**

If a loose soil or dry sand impression is located, it should be pre-treated prior to casting.

a. Use an aerosol can of lacquer, shellac, or hairspray to harden the impression.

b. Hold the can approximately 18 inches above the impression and spray parallel to the print.

c. Allow a fine mist to settle on the print.

d. Let dry.

e. Repeat the procedure until the top layer of particles is held in a hard film binder. When thoroughly dried, the lacquer/shellac film will protect the impression from a gentle pouring of properly mixed Dental Stone.

f. See previously outlined instructions in Section B-2, pages 4-6 for using Dental Stone.

4. **Casting Snow Impressions**

Heat generated by curing Dental Stone will melt snow unless special precautions are taken. Impressions in snow can be cast using one of the following methods: Snow Print Wax or Dry Casting.

a. **Snow Print Wax**

1) To use the Snow Print Wax method, cover the impression with a layer of Snow Print Wax using the same process as applying lacquer/shellac to impressions in sandy soil (as previously outlined in Section B-3, page 5.. The impression may need 4-6 coats of Snow Print Wax.

2) Lay the Dental Stone powder out on a sheet of paper so the powder becomes as cold as possible.

3) Mix snow with water in order to make the water as cold as possible. Any un-melted snow slush should be removed from the water before adding the Dental Stone powder.

4) See previously outlined instructions in Section B-2, pages 4-6 for using Dental Stone.

5) Allow the snow print cast to set up for at least **two hours** before removing it. Take caution not to disturb the wax because the impression is preserved in the wax, not the cast.

b. **Dry Casting**

1) To use the dry casting method, use a kitchen strainer or flour sifter to sift dry Dental Stone powder about 1/8 inch thick over the impression.

2) Using a fine mist spray bottle, spray COLD water over the Dental Stone until wet.

3) Repeat approximately 4 times or until a good base layer is formed.

4) Cast normally using cold Dental Stone and cold water as previously outlined in Snow Print Wax Casting in Section B-4, page 6-7.

5. **Casting Underwater Impressions**

a. Without disturbing the impression, try removing excess water with a small cup.

b. If the water cannot be drained away/removed from the impression, slowly sift or sprinkle dry Dental Stone powder into the water above the impression. The powder will sink to the bottom and gradually build up.

c. Once the dental stone is approximately 1 inch thick on top of the impression, cast normally as previously outlined in Section B-2, pages 4-6 for using Dental Stone.

C. Preserving Dust Impressions

1. Using a flashlight with subdued light, shine the flashlight at an oblique angle across the surface suspected of having a dusty impression.

2. Once an impression has been located, it should be photographed using techniques previously described in Section A, but the camera's detachable flash should be placed approximately 2-3 feet from the impression so the light from the flash passes obliquely over the impression.

3. Once photographed, the impression can be recovered using an electrostatic dust print lifter, a tape lift, or gel lift. (All Indiana State Police District Crime Scene Investigators and Regional Laboratories are equipped with an electrostatic dust print lifter.)

4. Electrostatic dust print lifts should be packaged separately. Each electrostatic lift should be packaged in a cardboard box, such as a pizza box, with the dark side facing up. The edges of the electrostatic lift should be taped down in the box to prevent the dust particles from being disturbed.

D. Marking of Evidence

1. All evidence containers shall be marked with the contributing agency's name, case number, and item number. The container shall be properly sealed and the initials of the person who sealed the evidence shall be written so they are partially on the seal and partially on the container. Depending upon the evidence, the container should be marked prior to placing the evidence inside to prevent damage to the footwear/tire impression during the marking process.

2. Footwear/tire impressions that have been lifted with tape or gel lifts shall be marked on the back of the lifter and sealed in a manila envelope.

   Labeling Lifts – The following information should be included on the back of each lift:
   - Agency case number
   - Item number
   - Date the evidence was collected
   - Written description of item (including inside or outside surface location)
   - Sketch of the item with the location of the print indicated

- Direction/orientation of the print on the object
- Initials of the lifting officer

E. Submission of Footwear/Tire Impression Evidence

1. Footwear submitted for comparison should be packaged to prevent any additional wear to the outsoles.

    a. A pair of shoes can be submitted as one item; however, the outsoles should not be rubbing against one another.

    b. If the shoes are to be examined by both the Latent Print Identification Unit and the Trace Evidence Unit, the shoes should be packaged separately so as to keep the debris from the shoes separate.

2. The number of pieces of evidence inside an item container should be listed in the item description area of the Request for Laboratory Examination form. For example, the item description should read, “Sealed envelope containing two gel lifts with footwear impressions.”

3. Any footwear/tire impressions recovered can be submitted to a regional laboratory for entry into the Shoeprint Image Capture and Retrieval (SICAR) database or Tread Assistant to attempt to determine the make and model of the shoe or tire.

F. Comparison Test Impressions

1. Shoe Test Impressions

a. Any shoes that are obtained or recovered during the investigation should be submitted along with the unknown footwear impression(s) for comparison.

b. The laboratory analyst will create the appropriate footwear test impressions in the laboratory.

2. Tire Test Impressions

a. Tire test impressions must be made while the tires are still on the vehicle, and can be taken in the field with the aid of a district crime scene investigator.

b. After test impressions impressions are created, tires should be removed from the vehicle and identified as to wheel position and direction of rotation, before being submitted to the laboratory.

1) If tires are unable to be retained, high quality photographs of each section of each tire should be taken and submitted to the laboratory.

2) Not submitting the tires or photographs of the tires will limit the analyst's examination and conclusions.

c. Tires can be tagged for laboratory submission instead of packaged.

3. If footwear/tire impression evidence could contain footwear/tire impressions from officers or first responders at a scene, elimination exemplars of the shoes or tires should be submitted.

G. Explanation of Results

The following are examples of results and what each result means:

1. The footwear/tire impression was in agreement in size, shape, tread design, and identifying characteristics with the left/right shoe/tire; therefore, the impression was identified as having been made by…

   *This means that the examiner has determined that the unknown footwear/tire impression **was** made by that specific shoe/tire.*

2. The footwear/tire impression disagreed in tread design with the shoes/tires; therefore, the impression was not made by …

   *This means the unknown footwear/tire impression **was not** made by the submitted shoe/tire.*

3. The footwear/tire impression was in agreement in size, shape, and tread design with the right/left shoe/tire; therefore, the impression could have been made by the right/left shoe/tire or any other right/left shoe/tire with the same size, shape, and tread design.

   This means that the unknown footwear/tire impression was in agreement with class/manufacturing characteristics only, and could not be positively identified to the submitted shoe/tire. This could be due either to the quality of the unknown impression, or due to the lack of wear and identifying characteristics on the submitted shoe/tire.

4. The footwear/tire impression was in agreement in size, shape, tread design, and had limited identifying characteristics with the right/left shoe/tire; therefore, the impression could have been made by the right/left shoe/tire.

   This means that the unknown footwear/tire impression has class/manufacturing characteristics in agreement with the left/right shoe/tire, and some characteristics in agreement with the right/left shoe/tire that were not from the manufacturing process; however, there was not enough of these unique identifying characteristics present to make an identification. Therefore, the result is that the shoe/tire could have made the unknown impression.

5. The footwear/tire impression was in agreement in shape and tread design with the right/left shoe/tire; however, due to the lack of a scale present in the photographs, the size of the impression was unable to be compared.

   This means that the unknown footwear/tire impression shares the general tread design of the submitted shoe/tire, but without a scale, the size aspect was unable to be compared.

6. The footwear/tire impression lacks a definitive footwear/tire shape and tread design; therefore, the impression is not suitable for entry into the Shoeprint Image Capture and Retrieval (SICAR)/Tread Assistant database.

   This means that some kind of impression was observed; only one or two possible elements may have been observed and they may or may not be a footwear/tire impression. Due to this lack of information in the impression, the impression is not able to be searched in databases to determine a possible source for the impression.

7. As a result of the SICAR/Tread Assistant entry, it was found that the footwear/tire impression is consistent with having been made by the tread design depicted on the outsole of a _____ (make and model of shoe/tire). If shoes/tires with a tread design resembling the outsole of a _____ (make and model of shoe/tire) are collected, please submit them to the laboratory for further analysis.

   This means that the unknown footwear/tire impression appears to have the same general tread design as this make and model of shoe/tire. If during the course of the investigation shoes/tires of this make and model, or shoes/tires with the same general tread design as this make and model are collected, they should be submitted for a comparison examination.

For questions, consultation, or assistance, latent print analysts can be reached by calling the appropriate regional laboratory during normal business hours, Monday through Friday, 8:00 a.m. to 4:30 p.m., or after normal business hours by contacting the Indiana State Police District Crime Scene Investigator.

Indianapolis Regional Laboratory
550 West 16th Street, Suite C
Indianapolis, IN 46202
(317) 921-5300 or (866) 855-2840
District 52-CSI: (800) 582-8440

Fort Wayne Regional Laboratory
5811 Ellison Road
Fort Wayne, IN 46804
(260) 436-7522
District 22-CSI: (800) 552-0976

Evansville Regional Laboratory
19411 Highway 41 North
Evansville, IN 47711
(812) 867-3157
District 35-CSI: (800) 852-3970

Lowell Regional Laboratory
1550 East 181st Avenue
Lowell, IN 46356
(219) 696-1835
District 13-CSI: (800) 552-8917